NCHRP 20-123(04)
DEVELOPMENT OF A RISK MANAGEMENT STRATEGIC PLAN AND RESEARCH ROADMAP

APPENDIX J
TASK 10 – RISK MANAGEMENT RESEARCH ROADMAP

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Table of Contents

Introduction

Background/Context

Conducted as part of NCHRP research study 20-123(04) titled "Development of a Risk Management Strategic Plan and a Research Roadmap", the Risk Management Research Roadmap was laid out in a workshop with DOT practitioners as well as other risk management professionals on August 18, 2021. The workshop gathered feedback on the content and prioritization of future research for a Research Roadmap advancing Risk Management in State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs).

In general, a Research Roadmap is built from (a) critical problems; (b) key drivers; (c) key knowledge gaps; (d) research to address these needs; and (e) a schedule. This workshop brought participants through each of those elements. As groundwork and to get participants thinking critically and constructively about Risk Management, the workshop began with a brainstorm of the critical problems and key drivers before jumping into an analysis on how to fix them.

The roadmap described here is designed to produce a list of research problem statements (RPSs) for possible inclusion in future research development cycles, supported and endorsed by American Association of State Highway and Transportation Officials (AAHSTO) committees and councils, the Federal Highway Administration (FHWA), and the Transportation Research Board (TRB). This Research Roadmap will pave the way for state departments of transportation (DOTs) and other partners to engage, plan, and program projects and activities in support of risk management.

Objective

The objective of the Risk Management Research Roadmap is to provide long-term guidance on future research and development activities related to risk management to be undertaken by the transportation industry in a coordinated fashion.

Methodology

Based on the Literature Review and Gap Assessment conducted in Task 2, the research team identified six key knowledge gaps in the state of practice:

- **Measurement and Quantification of Risk**: Risk has no meaning unless it can be tied to performance. Uncertainty that has no bearing on organizational goals and objectives, or whose impact cannot be measured, assessed, estimated, or

described is impossible to act upon. Agencies should understand which uncertainties could impact their ability to achieve their measurable performance goals.

- **Data and Tools:** As technology and data science continue to rapidly progress, the demands of DOT technical staff continue to expand. In some cases, the challenge lies not in finding needed data, but in processing the large amount of data available and translating it into actionable information.
- **Integration with Existing Process:** To achieve a significant and sustainable positive impact on agency operations, risk management must be embedded in many existing DOT business processes.
- **Communication and Coordination:** Coordination and communication are critical for managing risk. In a disaster or hazard situation, multiple agencies and sectors may need to respond at the same time. If response to risk is not collaborative and communication is not strong, it may be difficult to manage and mitigate hazards and the transportation system will be less resilient.
- **Retrospective Evaluation:** Much can be learned from considering responses to events that have already happened. Past events should be used to improve emergency response plans, operations, planning, etc. and to develop event probabilities and consequences associated with the events.
- **Workforce Capacity and Modernization:** The workforce of the future is constantly evolving, and agencies need to be able to address and handle the risk and opportunity that comes with it. Through investing in their work as well as providing more opportunities and benefits to employees, agencies can modernize and continue to manage the uncertainties ahead.

Using information gathered for the six key knowledge gaps, the research team developed 12 draft RPSs.

Initial Stakeholder Engagement

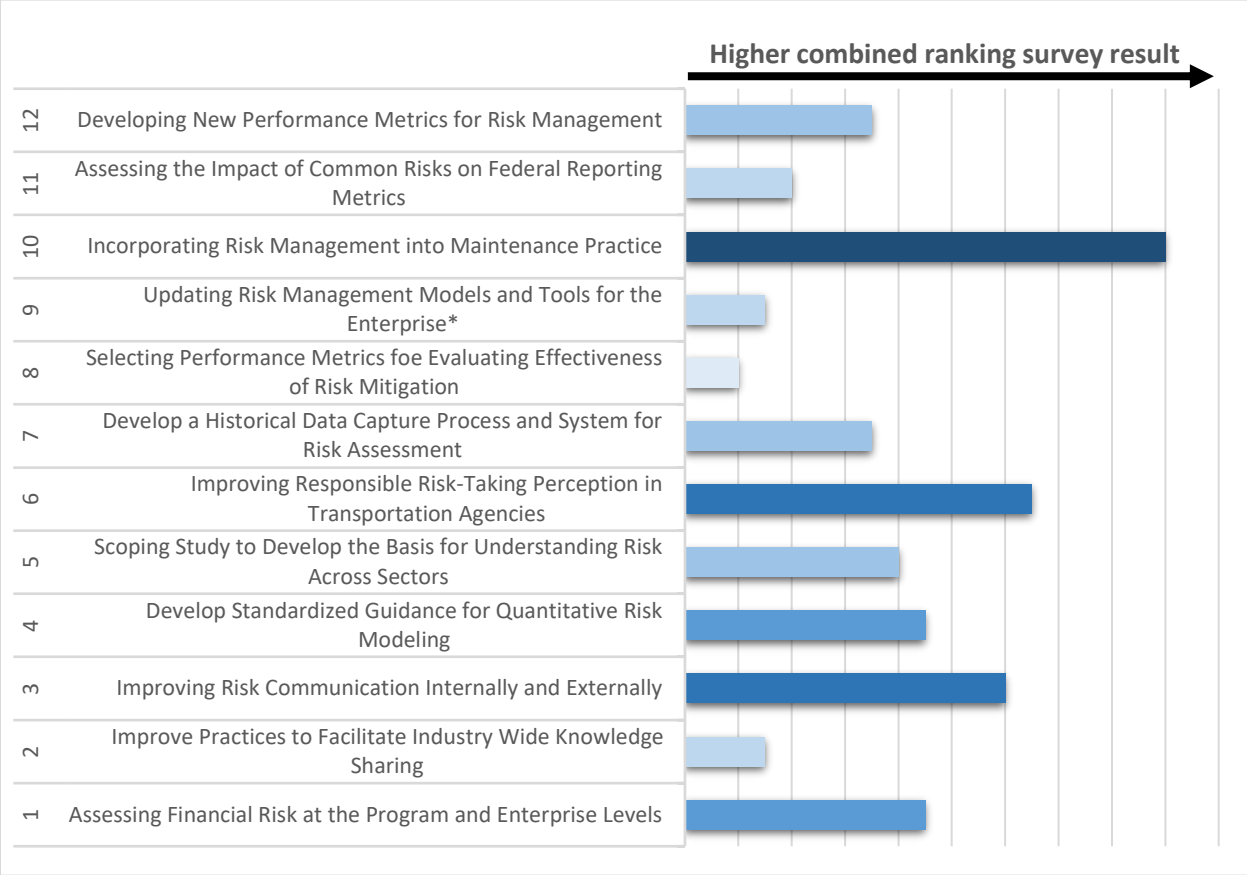
The draft RPSs were presented at two stakeholder engagements:

- As part of an agenda item for a bimonthly meeting of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Performance Based Management's Subcommittee on Risk Management on April 12, 2021, and
- As the principal agenda item for the AASHTO Committee on Transportation System Security and Resilience (CSSTR) on April 21, 2021.

The two stakeholder engagement events helped to obtain initial feedback on the conceptual problem statements in order to validate and prioritize the RPSs for incorporation on the Risk Management Research Roadmap. * One *RPS was altered post-survey per panel feedback and study development*

 presents the original list of draft RPSs presented at the two stakeholder events and the corresponding rankings provided by participants. The darker shade of blue represents the most important research that is needed based on the stakeholder events. Some of the RPSs have been modified since the engagement events based on participant feedback.

Figure 1 | Combined Ranking of Conceptual Problem Statements



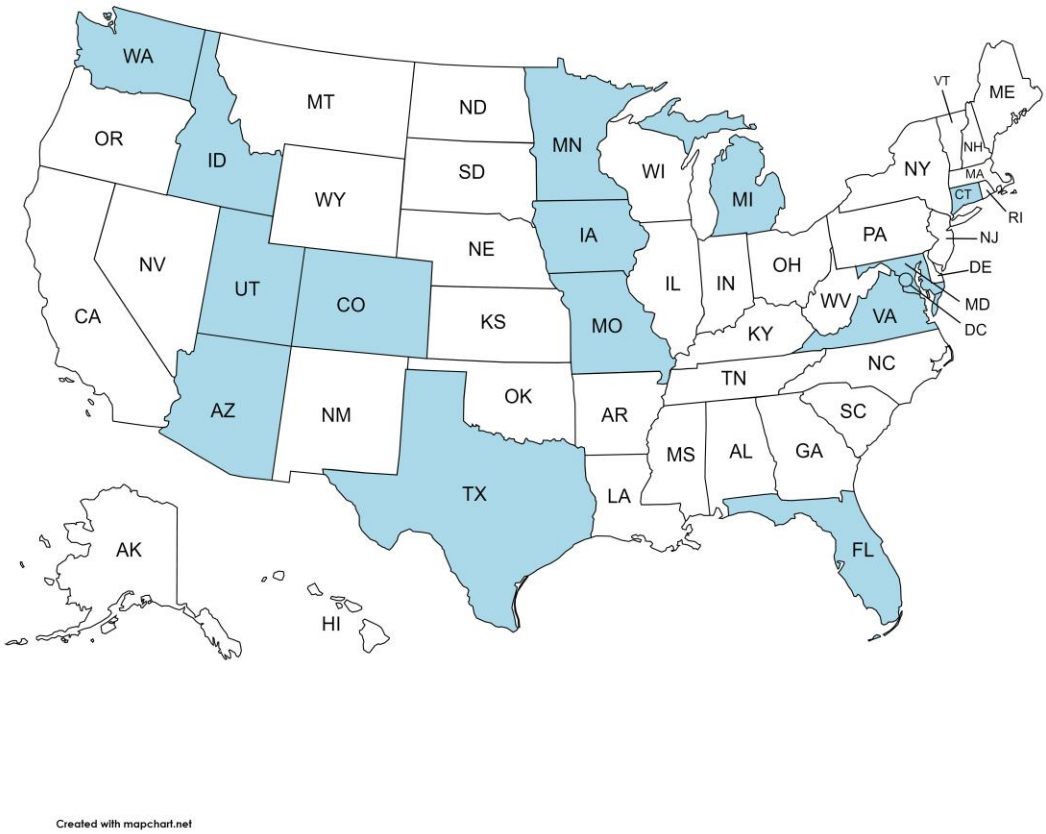
** One RPS was altered post-survey per panel feedback and study development*

Workshops

Based on feedback obtained at the stakeholder engagements, the RPSs were revised to be presented at a Risk Management Research Roadmap Workshop conducted on August 18, 2021. Similar to the previous stakeholder engagements, this workshop helped to gather feedback on the content and prioritization of future research for a Research Roadmap advancing Risk Management in DOTs and MPOs.

The Risk Management Research Roadmap Workshop engaged 19 participants representing state DOTs, FHWA and AASHTO. The participants represented geographic diversity, as demonstrated in Figure 2.

Figure 2 | Location of Participants



To increase participation and better feedback, participants were provided with read-ahead material containing the draft RPSs, a summary of the previous stakeholder engagements that helped to create the RPSs, and a list of relevant completed and ongoing research projects.

During the workshop participants were asked to identify critical problems, key drivers and needs, and parameters to develop research needs, research problem statements, and a timeline for prioritization. In addition, participants identified any missing topics corresponding to each of the six key knowledge gaps. The identification of missing topics led to the creation and prioritization of new RPSs. Along with project prioritization and urgency scores, the participants were able to provide input on the timeline which offered the research team a framework to create the research roadmap. Table 1 presents a list with the 20 final RPSs (original and new) obtained at the

workshop to be included in a 5-year research program by year. As a way to help close the key knowledge gaps, Table 2 identifies which problem statements help to address those key knowledge gaps. The final problem statements can be found in the Appendix.

Table 1 | Research Projects Nested with Knowledge Gaps

Measurement and Quantification of Risk	Data and Tools
6. Develop Standardized Guidance for Quantitative Risk Modeling	**13.** Assess the State of the Practice in Risk Assessment Processes and Tools
8. Scoping Study to Develop the Basis for Understanding Systemic Risks	**4.** Selecting Performance Metrics for Evaluating Effectiveness of Risk Mitigation
1. Assessing Financial Risk at the Program and Enterprise Levels	**2.** Develop a Historical Data Capture Process and System for Risk Management
11. Assessing the Impact of Common Risks on Federal Reporting Metrics	**12.** Developing New Performance Metrics for Risk Management
Integration with Existing Processes	**Communication and Coordination**
10. Incorporating Risk Management into Maintenance Practice	**5.** Improving Risk Communication Internally and Externally
9. Scoping Study to Develop the Basis for Understanding Risk Across Sectors	**19.** Establishing Risk Tolerance, Thresholds, and Legal Implications for Transportation Agencies
16. Understanding and Managing Risks of Work or Outside Assets in the Right-of-Way	**3.** Improve Practices to Facilitate Industry Wide Knowledge Sharing
Retrospective Evaluation	**Workforce Capacity and Modernization**
14. Measuring the Return-on-Investment of Risk Management	**7.** Improving Responsible Risk-Taking Perception in Transportation Agencies
15. Retrospective Assessment of Covid Response Efforts	**18.** Leveraging Existing Risk Practices Building on Success within your Agency
17. Assessment of Root Elements of Continuity-of-Business – Lessons from COVID-19	**20.** Strategies to Address DOT Modernization using a Risk Framework

To validate results from the Risk Management Research Roadmap Workshop, the research team conducted a meeting with the NCHRP 20-123(04) Technical Panel to discuss the final list of RPSs and the development of the research program.

Risk Management Research Roadmap

Based on input from the multiple stakeholder engagements and panel interaction, the research team developed the Risk Management Research Roadmap. The Roadmap is based on the six key knowledge gaps with the corresponding RPSs to help transportation agencies advance risk management. Research was nested within gaps to help agencies identify research relevant to their organization and personal needs. The proposed Risk Management Research Roadmap is presented in **Error! Reference source not found.**.

Figure 3 | Risk Management Research Roadmap

Key Knowledge Gaps	Workforce Capacity and Modernization	Retrospective Evaluation	Coordination and Communication	Integration with Existing Process	Data and Tools	Measurement & Quantification of Risk	Risk Management Research Roadmap – Potential Projects
Asses the State of Practice in Risk Assessment Processes and Tools **(#13)**					●		
Develop Standardized Guidance for Quantitative Risk Modeling **(#6)**						●	
Improving Responsible Risk-Taking Perception in Transportation Agencies **(#7)**	●						
Measuring the Return-on-Investment of Risk Management **(#14)**		●					
Retrospective Assessment of Covid-19 Response Efforts **(#15)**		●					
Improving Risk Communication Internally and Externally **(#5)**			●				
Incorporating Risk Management into Maintenance Practice **(#10)**				●			
Scoping Study to Develop the Basis for Understanding Risk Across Sectors **(#9)**				●			
Understanding and Managing Risks of Work or Outside Assets in the Right-of-Way **(#16)**				●			
Assessment of Root Elements of Continuity-of-Business – Lessons from Covid-19 **(#17)**		●					
Scoping Study to Develop the Basis for Understanding Systemic Risks **(#8)**						●	
Leveraging Existing Risk Practices Building on Success within your Agency **(#18)**	●						
Assessing Financial Risk at the Program and Enterprise Levels **(#1)**						●	
Selecting Performance Metrics for Evaluating Effectiveness of Risk Mitigation **(#4)**					●		
Establishing Risk Tolerance, Thresholds, and Legal Implications for Transportation Agencies **(#19)**			●				
Strategies to Address DOT Modernization using a Risk Framework **(#20)**	●						
Assessing the Impact of Common Risks on Federal Reporting Metrics **(#11)**						●	
Develop a Historical Data Capture Process and System for Risk Management **(#2)**					●		
Improve Practices to Facilitate Industry Wide Knowledge Sharing **(#3)**			●				
Developing New Performance Metrics for Risk Management **(#12)**					●		

Framework

At the start of this project, an in-depth state of review was developed including a literature review on current and existing research to identify gaps and opportunities for growth. below lists the applicable projects that have been identified as relevant to this current NCHRP project. Recognizing the existing research projects allowed the research team to create new RPSs to elaborate on the established key knowledge gaps. This helps ensure there is no overlap between the new RPSs and ones that have already been completed or are currently being produced.

Figure 4 | Risk Management NCHRP Related Projects

Key Knowledge Gaps	Workforce Capacity and Modernization	Retrospective Evaluation	Coordination and Communication	Integration with Existing Process	Data and Tools	Risk Measurement and Quantification
NCHRP 08-36(121) Successful Implementation of Enterprise Risk Management in State Transportation Agencies						●
NCHRP 08-36(126) Development of a Risk Register Spreadsheet Tool					●	
NCHRP 08-36(146) Economic Resilience and Long-Term Highway/Transportation Infrastructure Investment	●					
NCHRP 08-60 Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs				●	●	
NCHRP 08-70 Uses of Risk Management and Data Management to Support Target-Setting for Performance-Based Resource Allocation by Transportation Agencies		●				
NCHRP 08-93 Managing Risk Across the Enterprise: A Guidebook for State Department of Transportation				●		●
NCHRP 08-108 Developing National Performance Management Data Strategies to Address Data Gaps, Standards, and Quality					●	
NCHRP 12-43 Bridge Life Cycle Cost Analysis				●	●	
NCHRP 15-61 Applying Climate Change Information to Hydrologic and Hydraulic Design of Transportation Infrastructure				●	●	

Completed

Risk Management – Relevant NCHRP Projects

Risk Measurement and Quantification	Data and Tools	Integration with Existing Process	Coordination and Communication	Retrospective Evaluation	Workforce Capacity and Modernization	Key Knowledge Gaps
		●				**NCHRP 20-07(378)** Assessing Risk for Bridge Management
		●				**NCHRP 20-24(71)** Guide for Managing NEPA-Related and Other Risks in Project Delivery
●						**NCHRP 20-24(74)** Executive Strategies for Risk Management by State Departments of Transportation
				●		**NCHRP 20-24(80)** Assessing the Economic Benefit of Transportation Infrastructure Investment in a Mature Surface Transportation System
●	●	●	●	●	●	**NCHRP 20-59 (14C)** Understanding Transportation Resilience: A 2016-2018 Road Map
●						**NCHRP 20-59(51)**A Security 101: A Physical & Cyber Security Primer for Transportation Agencies
●	●	●	●	●	●	**NCHRP 20-59(54)** Transportation System Resilience: Research Roadmap and White Papers
		●				**NCHRP 20-101** Incorporating the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change – Guidebook
		●				**NCHRP 24-25** Risk-Based Management Guidelines for Scour at Bridges with Unknown Foundations
		●				**NCHRP 24-34** Reference Guide for Applying Risk and Reliability-Based Approaches for Bridge Scour Prediction
		●				**NCHRP 24-44** Guidelines for Managing Geotechnical Risks in Design-Build Projects
		●				**NCHRP Synthesis 103** Risk Assessment Processes for Hazardous Materials Transportation
		●		●		**NCHRP Synthesis 494** Life-Cycle Cost Analysis for Management of Highway Assets

Risk Measurement and Quantification	Data and Tools	Integration with Existing Process	Coordination and Communication	Retrospective Evaluation	Workforce Capacity and Modernization	Key Knowledge Gaps	
				●		**NCHRP Synthesis 20-05/Topic 50-15** Asset Management Approaches to Identifying and Evaluating Assets Damaged Due to Emergency Events	
●	●	●	●		●	**NCHRP 08-113** Integrating Effective Transportation Performance, Risk, and Asset Management Practices	Current
		●				**NCHRP 08-118** Risk Assessment Techniques for Transportation Asset Management	
				●		**NCHRP 08-124** Quantifying the Impacts of Corridor Management	
●	●	●				**NCHRP 10-102** A Guidebook for Risk-Based Construction Inspection	
●	●	●				**NCHRP 15-71** Contingency Factors to Account for Risk in Early Construction Cost Estimates for Transportation Infrastructure Projects	
●						**NCHRP 15-80** Design Guide and Standards for Infrastructure Resilience	
		●				**NCHRP 20-06 Topic 25-03** Managing Enhanced Risk in the 'Mega Project' Era	
	●	●	●	●	●	**NCHRP 20-44(02)** Implementation of the AASHTO Guide for Enterprise Risk Management	
			●			**NCHRP 20-59 (55)** Transportation System Resilience: CEO Primer & Engagement	
	●		●			**NCHRP 20-127** Business Case and Communications Strategies for State DOT Resilience Efforts	
		●				**NCHRP 23-09** Scoping Study to Develop the Basis for a Highway Standard to Conduct an All-Hazards Risk and Resilience Analysis	

Appendix. Potential Projects – Research Problem Statements

The proposed RPSs for each Key Knowledge Gap for NCHRP 20-123(04) are:

- **Risk Measurement and Quantification**
  - Develop Standardized Guidance for Quantitative Risk Modeling (#6)
  - Scoping Study to Develop the Basis for Understanding Systemic Risks (#8)
  - Assessing Financial Risk at the Program and Enterprise Levels (#1)
  - Assessing the Impact of Common Risks on Federal Reporting Metrics (#11)

- **Data and Tools**
  - Asses the State of Practice in Risk Assessment Processes and Tools (#13)
  - Selecting Performance Metrics for Evaluating Effectiveness of Risk Mitigation (#4)
  - Develop a Historical Data Capture Process and System for Risk Assessment (#2)
  - Developing New Performance Metrics for Risk Management (#12)

- **Integration with Existing Process**
  - Incorporating Risk Management into Maintenance Practice (#10)
  - Scoping Study to Develop the Basis for Understanding Risk Across Sectors (#9)
  - Understanding and Managing Risks of Work or Outside Assets in the Right-of-Way (#16)

- **Communication and Coordination**
  - Improving Risk Communication Internally and Externally (#5)
  - Establishing Risk Tolerance, Thresholds and Legal Implications for Transportation Agencies (#19)
  - Improve Practices to Facilitate Industry Wide Knowledge Sharing (#3)

- **Retrospective Evaluation**
  - Measuring the Return-on-Investment of Risk Management (#14)
  - Retrospective Assessment of Covid Response Efforts (#15)
  - Assessment of Root Elements of Continuity-of-Business – Lessons from COVID-19 (#17)

- **Workforce Capacity and Modernization**
  - Improving Responsible Risk-Taking Perception in Transportation Agencies (#7)
  - Leveraging Existing Risk Practices Building on Success within your Agency (#18)
  - Strategies to Address DOT Modernization using a Risk Framework (#20)

The following section presents descriptions of all proposed RPSs on the Risk Management Research Roadmap.

1. Assessing Financial Risk at the Program and Enterprise Levels

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Background: Financial risks can threaten the strategic objectives of transportation agencies - e.g., the safe and reliable and efficient movement of people and goods). For example, the Highway Trust Fund is tied to taxes on gas and diesel. However, the recent COVID pandemic greatly reduced American consumption, thus dramatically reducing revenues. State DOTs have seen their budgets slashed by 30% or more, forcing delays in some projects. On the other hand, external mandates can impose both risks and opportunites. A well-funded mandate could mean state DOTs have additional funding for enhancing resilience, while an unfunded mandate could force a DOT to choose between maintenance and projects. The objective of this project is to help transportation leaders with decision tools for deciding how to allocate resources when subjected to unpredicatable financial conditions.

Objectives:

The purpose of this research is to:

1) Gather current state of practice on the topic.
2) Develop a methodology for identifying financial risk.
3) Develop a process for quantifying enterprise financial risk.
4) Develop a process for quantifying program financial risk.
5) Develop metrics and performance indicators for evaluating effectiveness of financial risk countermeasures.
6) Develop decision-making tools for resource allocation under conditions of financial uncertainty.
7) Develop methodology and guidance on consideration of program and potentially project-level financial risk within the enterprise.
8) Pilot-test the developed processes with multiple state DOTs.

Estimated Duration: 18-24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Financial Risk

Subject: Risk Management

2. Develop a Historical Data Capture Process and System for Risk Assessment

Background: Surveys of state DOTs reveal that one of the barriers to conducting quantitative risk assessments is the uncertainty surrounding impacted elements, costs, and mitigating countermeasures applied to events likelihood. Further, transportation agencies generally do not have adequate databases or recording mechanisms for tracking past events. A frequently cited barrier to quantitative risk modeling is insufficient or inaccurate data for determining threat likelihoods, vulnerability, and consequences. Having a mechanism in place to capture data from events as they occur would help transportation agencies derive the threat frequencies, vulnerabilities, and consequences needed for quantitative risk models which could invlude economic costs, agency costs and other factors. This project aims to develop a framework/process for recording and analyzing historical data.

Objectives:

The objectives of this research are:

1) Develop data collection and input guidance.

2) Develop a metadata template, data dictionary and database schema for a risk management database that facilitates the searching and sharing of threat, asset, consequence, and other risk-related data.

3) Develop training material on how to use and implement these products.

Estimated Duration: 12- 18 Month

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Data Management

Subject: Risk Management

3. Improve Practices to Facilitate Industry Wide Knowledge Sharing

Background: MAP-21 and the FAST Act requires transportation agencies to develop performance-based asset management plans as well as periodically reassess their systems to identify repeatedly damaged assets. This compels agencies to itemize their risk exposure in a systemwide risk management plan. While transportation agencies are increasing their focus on risk, lingering gaps include sufficient data and the siloing of risk management efforts. A frequently cited barrier to performing risk assessments is inadequate data for determiningthreat likelihood, vulnerability, and consequences. Too, there is growing awareness that risk asessments should recognize the interdependencies across realms – infrastructural, economic, soil, political, etc., as opposed to treating risks separately. Developing a centralized technology-based process for sharing risk-related data, coupled with decentralized access, as well as policies to enhance intra-agency communication, and policies to foster parternships with external agencies (state, local, MPOs, tribes) would help close these gaps. Additional benefits include the avoiding the duplication of effort, increasing efficiency, and decreasing response times. It is the goal of this project to help transportation agencies develop a framework for information sharing, both internally and externally.

Objectives:

The objectives of this research are:

1) Develop a complete cradle-to-grave collaborative process such that data is clearly specified, efficiently collected, and readily shared.
2) Develop a searchable knowledge base.
3) Develop policies and procedures for sharing data within the agency.
4) Develop policies and procedures for sharing data externally.

Estimated Duration: 18 -24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Data Management

Subject: Risk Management

4. Selecting Performance Metrics for Evaluating Effectiveness of Risk Mitigation

Background: The final phase of risk management is to evaluate the effectiveness of implemented mitigation measures through performance monitoring. At the asset level, one option is to reasses an asset's failure probability post-mitigation. At the system level, a reassessment of network service functions – flow capacity, connectivity, etc. – may be best. At the project, program, or enterprise level, suitable metrics could be reassessments of whether a planned goal has been achieved, for example:

- A project has been delivered on time (project level);
- An agency's bridge program reduced the percentage of deficient bridges to beneath the target goal (program level);
- Staff crossed trained in risk management (enterprise level).

Objectives:

The purpose of this research is to:

1) Evaluate existing performance metrics for risk management at different levels.
2) Develop performance metrics for asset level risk.
3) Develop performance metrics for system level risk.
4) Develop performance metrics for project level risk.
5) Develop performance metrics for program level risk.
6) Develop performance metrics for enterprise level risk.

Estimated Duration: 18 – 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Risk Metrics

Subject: Risk Management

5. Improving Risk Communication Internally and Externally

Risk communication is the act of informing people about potential threats to people and infrastructure for the objective of saving life and property. Effective communication promotes the recovery of disrupted systems while maintaining public confidence. However, barriers to effective communication exist, both internally and externally. The primary barrier to internal communication is organizational "siloing". Staff working within different functional areas, such as safety, operations, and emergency management, may feel little incentive to collaborate if they believe their missions are independent of other departments. Organizational silos result in duplication of effort and inefficiency. Barriers to external communications with outside agencies stem from a lack of established two-way communications channels, while barriers to communications with the public include rumors, lack of expert consensus, over-hyped reporting, ethnic differences, and so on. Overcoming these obstacles requires:

- Organizational support
- Inter- and intra-agency collaboration
- Partnerships with community organizations
- Messaging that accurately portrays hazard likelihood, severity, location, affected population, and uncertainty
- Selection of the appropriate messaging vehicle (email, variable message sign, web site, etc.)

Objectives:

The purpose of this research is to:

1) Develop guidance for establishing intra-agency communication.
2) Develop guidance for establishing external partnerships and two-way communications channels with community organizations.
3) Develop guidance for crafting an effective communication strategy with materials (i.e.., metrics, dashboards, regular reports) with a clear explanation of uncertainty.
4) Develop guidance for determining the appropriate message vehicle.

Estimated Duration: 18 – 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Risk Communication

Subject: Risk Management

6. Develop Standardized Guidance for Quantitative Risk Modeling

Past surveys of state transportation agencies have revealed that the risk register is the most popular tool for prioritizing risks. Risk registers maybe best suited for enterprise or program level risk analysis. However, risk registers, heat maps, and other such qualitative approaches do not enable economic analysis of alternative adaptation strategies and, therefore, might not be adequate by themselves for asset or project level analysis, or any situation where economic analysis is required. The Pipeline Hazardous Materials and Safety Administration (PHMSA) has asserted that quantitative models provide greater insights into risk and greater support for decision making; but transportation agencies have been reluctant to adopt quantitative and probabilistic modeling. A common barrier is the perceived complexity, lack of trained personnel, and lack of data. To help eliminate these barriers, a standard is needed to guide transportation agencies on quantitative modeling techniques and data needs. The NCHRP 23-09 project, currently underway, focuses on developing the scoping study and roadmap to develop an all-hazards risk and resilience standard for highway assets. However, there is still a need to develop a standard for: 1) guidance on what are the most suitable risk assessment methodologies for asset, activity, project, program, and enterprise levels and 2) what are the best quantitative modeling techniques and data needs.

Objectives:

The objectives of this research are:

1) Investigate which risk methodologies, qualitative or quantitative, are most appropriate for each level of activity (asset, activity, program, project, enterprise).
2) Investigate quantitative models for estimating likelihood, vulnerability, direct and indirect consequences.
3) Investigate methodologies for quantifying uncertainty.
4) Investigate the data needs and necessary inputs to support a quantitative model for man-made and natural hazards.

Estimated Duration: 18 – 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Quantitative Modeling

Subject: Risk Management

7. Improving Responsible Risk-Taking Perception in Transportation Agencies

Background: Leaders should be champions for responsible risk taking in their agencies. However, the lack of efficient internal communication and tools to demonstrate the value added of responsable risk taking make this practice a challenge. There is a need to demonstrate the value added of positive risk-taking, making risk practical and illustrating the risk-reward balance for typical agency decisions. Embedded in this is the need to present a positive view of risk-taking – that risk is not synonymous with hazard or danger and that controlled experimentation and productive failure can be critical for evolving an organization over time.

Objectives:

The objectives of this research are:

1) Identifying current state of practice regarding adoption of responsible risk taking in organizations.
2) Conduct Gap Assessment of the state of practice.
3) Develop case studies of agencies (transportation or other sectors) where responsible risk taking is an effective practice.
4) Develop a process for effectively inter-agency risk communication.
5) Develop a process to identify and record the benefits of positive risk taking and risk-tolerance.
6) Development policies to encourage a culture of responsible risk considerations.

Estimated Duration: 18 - 24 Months

Estimated Budget: $150,000 - $200,000

Potential Funding Source: NCHRP

Topics: Risk Communication

Subject: Risk Management

8. Scoping Study to Develop the Basis for Understanding Systemic Risks

Background:

Risk assessment methodologies and tools have tended to analyze risk at the asset level and not the system as a whole. A 2018 RAND report noted the importance of understanding the interconnectedness of the transportation system and how it is impacted by all possible hazards. Guidance is needed to help transportation professionals develop an approach to risk assessment at the system level. A system-wide approach brings up the issue of scale and granularity. Thus any guidance considering a system-wide approach should include how to select the proper unit for analysis. For example, treating each road-, bridge-, or culvert-hazard interaction as an independent event could result in overcounting. Instead, risk for one or more asset-types could be aggregated spatially according to a homogenous unit, such as census tract, maintenance region, corridor, watershed, etc. In addition, transportation professionals need guidance on metrics and how to communicate risk. For example, risk can be expressed in terms of percentage of repair cost, average annualized loss, number of days required for restoration, per capita economic loss, etc. It is the objective of this project to help transportation professionals grapple with the complexity of assessing risk system-wide.

Objectives:

The objectives of this research are to:

1) Develop guidance to help owners and operators analyze risk across the transportation system as a whole.
2) Develop guidance for aggregating risk across assets and the network.
3) Develop guidance on how to communicate system-wide risk.

Estimated Duration: 18 – 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Systemic Risk

Subject: Risk Management

9. Scoping Study to Develop the Basis for Understanding Risk Across Sectors

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Background: The RAND corporation has pointed out that transportation should be viewed as a system of systems. The interdependencies between lifelines means that the loss of one can result in failure in another. However, how risk propagates across modes and sectors is not well understand. Guidance is needed to help transportation professionals develop an approach to risk assessment at the system level as well as address the interdependencies between transportation and other critical systems. Transportation planners will need new tools, metrics, and methodologies for communicating risk that spans across multiple sectors.

Objectives:

The objectives of this research are to:

1) Develop guidance to help owners and operators better understand the risks across adjoining systems, jurisdictions, modes, and critical dependent infrastructures.
2) Develop procedures and tools for evaluating cross-sector risk.
3) Develop guidance for communicating cross-sector risk.

Estimated Duration: 18 – 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Systemic Risk

Subject: Risk Management

10. Incorporating Risk Management into Maintenance Practice

Background: FHWA Directive 5520 encourages state DOTs to develop risk-based, cost effective strategies to minimize the impacts of climate change. Environmental stressors, such as extreme heat and extreme cold, and changes in the frequency and magnitude of extreme events, is changing the lifecycle of transportation assets; i.e, reducing service life, shortening replacement cycles, and increasing maintenance costs. Maintenance personnel offer valuable insight as to the costs associated with achieving performance goals. At the same time, maintenance personnel will require guidance as to how to incorporate risk models into maintenance, inspection, replacement, and repair cycles so that scheduled and routine maintenance continue to mitigate the risk from asset deterioration.

Objectives:

The purpose of this research is to:

1) Develop guidance or a framework on how to integrate risk into maintenance practice.
2) Develop methodologies for determining how to adjust maintenance cycles under non-stationary conditions.
3) Develop methodologies for estimating changes in maintenance costs due to non-stationary conditions.

Estimated Duration: 18 – 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Maintenance

Subject: Risk Management

11. Assessing the Impact of Common Risks on Federal Reporting Metrics

Background: Prior rulemaking and research from NCHRP and FHWA has established performancemetrics required for federal reporting (e.g., asset condition, system performance, safety) and risk registers accounting for asset, system, project, program, and enterprise-level risks in various agencies, all documented in a TAMP.

Risk management rests on being able to quantify the value of various risks. As FHWA has established which performance metrics matter most at the federal level, it is necessary to study, describe, and quantify where possible, the impact of frequently-cited risks to those metrics specifically.

For example: are agencies concerned about the federal "penalty" for missing the 10% poor NHS deck area target? Do they see cascading impacts for the loss of investment flexibility across their programs? Which risks in their risk register have the most influence on whether they can pass the threshold?

Objectives:

The purpose of this research is to:

1) Gather commonly cited asset, system, project, program, and enterprise-level risks from TAMPs and prior research.
2) Document practitioners' lived experience on how these risks can and do impact all aspects of federal performance reporting.
3) Quantify where possible the probabilistic impact of commonly cited risks on federally reported metrics, including impact on the metric itself (e.g., effect on the value reported) and impact to the agency (e.g., "penalty" loss of investment flexibility).
4) Report on the most impactful risks.

Estimated Duration: 18 - 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Risk Metrics

Subject: Risk Management

12. Developing New Performance Metrics for Risk Management

(This RPS could also be called: "Developing Performance Metrics for Value-Add Benefits")

Background: All risk management rests on being able to quantify the value of various risks. In some cases, value can be established by tying uncertainty to existing performance metrics (e.g., for asset condition or safety). In addition, however, agenices may wish to quantify the value-add of their risk management efforts themselves.

In some cases, it may be enough to simply assess the productivity of the program (e.g., "we have met X% of our risk mitigation goals in the fiscal year"). In others, agencies could delve deeper into valuation in terms of money saved, staff-hours saved, or reduction in the typical unit cost or time required for repeated activities, among others.

Objectives:

The purpose of this research is to:

1) Document practitioners' ideas and preferences for assessing the value-add of risk management programs.
2) Gather best practices for valuing risk management, uncertainty management, and efficiency-building across the public and private sectors.
3) Develop practical, actionable guidance for valuing risk management in transportation agencies.

Estimated Duration: 18 - 24 Months

Estimated Budget: $400,000 - $500,000

Potential Funding Source: NCHRP

Topics: Risk Metrics

Subject: Risk Management

13. Assess the State of the Practice in Risk Assessment Processes and Tools

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Background: During recent scans of transportation agencies, transportation professionals consistently reveal the need for processes and tools to assist agencies in conducting risk and resilience assessments of their systems. Conducting a domestic scan will help to gather current practices from different states, identify best practices, compile an inventory of existing tools, and identify gaps that suggest the need for developing methodologies and new tools. This project will help with the development of more comprehensive and standardized processes and tools to conduct risk assessments at different levels.

Objectives:

The purpose of this research is to:

1. Conduct a domestic desk scan, including detailed literature review, to develop a comprehensive list of existing risk assessment methodologies and tools (spreadsheet, software, etc.) used by transportation agencies. Some of the topics the search should include:
    a. Risk assessment level (e.g., enterprise, network, asset, project, etc.)
    b. Type of risk analysis (e.g., qualitative, quantitative, combination)
    c. Threat characterization.
    d. Vulnerability analysis, damage curves, etc.
    e. Consequence analysis (e.g., losses to the agency, cost to the user, cost of disruption, operational and maintenance costs, etc.)
    f. Process to identify mitigation alternatives.
2. Assess the maturity of agencies regarding the incorporation of risk management processes and tools.
3. Identify best practices and needs to develop a plan of action to fill the gaps and integrate existing methodologies and tools.

Estimated Duration: 12 Months

Estimated Budget: $150,000 - $200,000

Potential Funding Source: NCHRP Synthesis

Topics: Critical Infrastructure

Subject: Risk Assessment

14. Measuring the Return-on-Investment of Risk Management

Background: The best way to gain executive support and championship of enterprise risk management (ERM) is by making the case in dollars, cents, and hours of staff time. While guidance for ERM in transportaiton agencies exists, it generally focuses on the nuts-and-bolts of how ERM can be organized and run and discusses qualitative beneits such as "efficiency" and "communication" without quantitative assessment of the return-on-investment, or ROI. To compute ROI, one first needs to assess the costs of a practice (the "I" part) and then quantitatively estimate the return in consistent units to compute the ratio.

Objectives:

The purpose of this research is to:

1. Explore ways to measure the costs and benefits of ERM in transportation agencies and select a common unit.
2. Develop a methodology to estimate a "typical" investment in ERM at a transportation agency.
3. Develop a methodology to estimate a "typical" benefit from ERM at a transportation agency. This could include hours saved due to increased staff efficiency, increased budgets won through better communication and perceived prudence, hazards mitigated, life cycle costs reduced through preventive maintenance, etc.
4. Research what ROI for ERM can be in other sectors and industries if it has been estimated there. This should reinforce the computed ROI from costs and benefits.
5. Compute a "typical" ROI for ERM and defend it with data.

Estimated Duration: 18-24 months

Estimated Budget: $150,000 - $200,000

Potential Funding Source: NCHRP

Topics: Benefit-Cost Analysis

Subject: Risk Management

15. Retrospective Assessment of Covid Response Efforts

Background: The Covid-19 pandemic tested systems across the nation in unprecedented ways in modern transportation. Policies prepared prior to the event as well as emergency response efforts as the pandemic impacts unfolded hold critical lessons learned in evaluation, preparation and response to a systems-wide impact such as this event created. Although the impacts of some response efforts will require further time to recognize, others can be researched and applied to positively impact Risk Management practices in the short term.

Objectives:

The purpose of this research is to:

1. Conduct a nation-wide industry scan of Covid-19 response efforts along with anticipated and observed outcomes from each of the range of these efforts.
2. Develop evaluation process to grade effectiveness of response effort according to the intended and actual need of the situation.
3. Develop guidance to present evaluation results along with applicability to potential similar future events as well as Risk Management practices more generally.

Estimated Duration: 18-24 months

Estimated Budget: $150,000 – $200,000

Potential Funding Source: NCHRP

Topics: Covid-19

Subject: Risk Management

16. Understanding and Managing Risks of Work or Outside Assets in the Right-of-Way

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Background: Asset-level risk registers in transportation agencies often focus on natural disasters (e.g., floods, earthquakes, rockfalls). Some also address human-made hazards such as vehicle impacts. Few address the potential for outside assets and work in the right-of-way (ROW) to cause damage to assets or impact customer service. Utilities and other permitted outside actors can cut through pavement, damage curbing and drainage, relocate or rebuild assets incorrectly (such as a telephone pole in the middle of the sidewalk), and obstruct traffic, with the resulting costs and complaints potentially falling to the DOT (the public likely does not distinguish among the actors causing construction delays).

Objectives:

The purpose of this research is to:

1. Assess the prevalence of asset damage and customer service impacts to DOTs from outside work or assets in the ROW.
2. Assess the impacts of different types of outside work-related events in terms of dollars and hours of delay, as well as staff hours to resolve.
3. Explore how DOTs can address the risk of outside assets and work and find best practices.

Estimated Duration: 12 – 18 Months

Estimated Budget: $150,000 - $200,000

Potential Funding Source: NCHRP

Topics: Dependency Threats, ROW

Subject: Risk Management

17. Assessment of Root Elements of Continuity-of-Business – Lessons from COVID-19

Background: While "global pandemic" may not have been the highest-likelihood risk on transportation agenices' registers prior to 2020, continuity-of-business is a concern not limited to pandemics. The elements of continuity-of-business impacts – costs, challenges, efficiencies and inefficiences of work-from-home; lack of access to in-office tools and sofware that cannot be accessed from home; loss of staff interaction and mingling; loss of in-person contact with partners, contractors, consultants, and customers; etc. – could be experienced in all or part of a transportation agency after many events. Large-scale flooding, earthquakes, fires, storm events, terrorist attacks, etc. can all cut an agency's districts, shops, regions, or headquarters off from their equipment and bases of operations. While another global pandemic may not occur for sometime after COVID-19 is behind us, the lessons of COVID-19 should be recorded while they are still fresh.

Objectives:

The purpose of this research is to:

1. Research concepts and best practices for continuity-of-business in transportation and other industries.
2. Conduct interviews or peer exchanges to explore how agencies needed to adapt to Covid-19 and which adaptations worked or failed.
3. Develop a list of discrete elements of continuity-of-business and actions that agencies can take to harden them, including organizational roles and potential costs.
4. Make a business case for continuity-of-business hardening by linking the elements to events other than global pandemic and illustrating the potential benefits of planning ahead.

Estimated Duration: 12 – 18 Months

Estimated Budget: $150,000 – $200,000

Potential Funding Source: NCHRP

Topics: Covid-19

Subject: Risk Management

18. Leveraging Existing Risk Practices and Building on Success within your Agency

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Background: As risk management practices mature in agencies across the country and industry, understanding the scope and effectiveness of existing practices should act as a firststep in maturing agency practices overall.

Objectives:

The purpose of this research is to:

1. Conduct agency interviews on existing risk management practices and their potential applicability to strategic practice goals.
2. Conduct industry webinar presenting best-practices in leveraging existing practices.
3. Develop guidance sharing case examples and practices and a scalable execution plan that be employed to take common and existing risk practices and mature them toward ultimate goals.

Estimated Duration: 18 Months

Estimated Budget: $200,000-$250,000

Potential Funding Source: NCHRP

Topics: Risk Practices

Subject: Risk Management

19. Establishing Risk Tolerance, Thresholds, and Legal Implications for Transportation Agencies

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Background: According to the Committee of Sponsoring Organizations of the Treadway Commission's (COSO) "Strengthening Enterprise Risk Management for Strategic Advantage", risk tolerance "reflects the acceptable variation in outcomes related to specific performance measures linked to objectives the entity seeks to achieve". In otherwords, risk tolerance is the range of acceptable results. A risk threshold, on the other hand, is a level of risk exposure above which risks are addressed and below which risks may be accepted. Understanding and determining risk tolerance and risk threshold is important to an organization for avoiding unacceptable losses. Establishing levels of risk tolerance will help determine the type and extent of actions required to treat risks, and the level of management attention required in managing and monitoring the risks. Risk tolerance and risk threshold should guide decision making and reflect the organizatin's mission, objectives, strategies, and values.

Objectives:

The purpose of this research is to:

1. Conduct a desk scan, including detailed literature review, to compile existing definitions, acceptable risk criteria, and legal ramifications of establishing a risk appetite and threshold.
2. Identify how agencies define and quantify risk tolerance and risk threshold, and what metrics are used.
3. Develop guidance/handbook to assist transportation agencies in establishing risk tolerance and thresholds.

Estimated Duration: 18 Months

Estimated Budget: $200,000 - $250,000

Potential Funding Source: NCHRP

Topics: Risk Tolerance

Subject: Risk Management

20. Strategies to Address DOT Modernization using a Risk Framework

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Background: Policies and practices are constantly changing at DOTs however the increasing pace in utilizing innovative methods to collect data, monitor assets, measure and forecast performance, etc., creates an increasingly opportunistic objective in modernizing DOT practices to capitialize on these abilities. Part of this process is finding where the gaps in process are which can include the utilization of a Risk Framework and correspondning data, tools, policies and organizational structure needs for a future-state agency.

Objectives:

The purpose of this research is to:

21. Conduct an industry scan of agency efforts in modernization and inclusion of Risk Management in evolving practice.
22. Identify emerging technologies being explored by DOTs and how they (could) apply to Risk Management.

Estimated Duration: 18 – 24 months

Estimated Budget: $150,000 – $200,000

Potential Funding Source: NCHRP

Topics: Transportation Agency Modernization

Subject: Risk Management